# NUGLEAR SCIENCE and ENGINEERING

THE RESEARCH JOURNAL OF THE AMERICAN NUCLEAR SOCIETY

DIXON CALLIHAN, Editor

MARGE WILLIAMS, Administrative Assistant

Union Carbide Corporation Nuclear Division Oak Ridge Y-12 Plant Oak Ridge, Tennessee 37830

#### EDITORIAL ADVISORY COMMITTEE

Manson Benedict
E. Richard Cohen
E. C. Creutz
Frank G. Dawson

A. F. Henry
A. A. Johnson
C. H. Millar
L. W. Nordheim
Hugh C. Paxton

D. H. Gurinsky Hugh Fred W. Thalgott

#### ANS OFFICERS

J. Ernest Wilkins, Jr. president

Melvin J. Feldman
vice president/president elect

Harry Lawroski treasurer

Raymond D. Maxson assistant treasurer

Octave J. Du Temple executive director

#### **ANS PUBLICATIONS STAFF**

Norman H. Jacobson publications manager

Ruth Farmakes special publications editor

Joann Hollensteiner
editorial coordinator

Nancy Zacha Godlewski copy editor

Diane R. Wojciechowski copy editor

Siegfried H. Krapp production manager

Dennis Weeks production assistant

# Volume 56 January, February, March, April 1975

#### COMPOSITION

Beljan, Dexter, Michigan 48130

NUCLEAR SCIENCE AND ENGINEERING is published monthly by the American Nuclear Society, Inc., with executive and business offices at 244 East Ogden Avenue, Hinsdale, Illinois 60521 - telephone 312/325-1991. The subscription rate is \$45 per volume or \$120 for three volumes per calendar year; single copies are \$15 (special issues slightly higher). Address subscription order to the publisher. (Back issues of Volumes 1-17 are available from Academic Press, 111 Fifth Avenue, New

York, New York 10003.) Second-class postage is paid at Hinsdale, Illinois, and at additional mailing offices. Printed in Danville, Illinois 61832, by Interstate Printers and Publishers, Inc. Copyright 1975 by the American Nuclear Society, Inc. Inquiries about the distribution and delivery of NUCLEAR SCIENCE AND ENGINEERING and requests for changes of address should be directed to the American Nuclear Society. Allow 6 weeks for a change to become effective.



Copyright @ 1975 by American Nuclear Society, Inc., Hinsdale, Illinois 60521

**VOLUME 56, NUMBER 1, JANUARY 1975** 

## **TECHNICAL PAPERS**

1	Rate of Liquid Entrainment at the Gas-Liquid Interface of a Liquid Submerged Sonic Gas Jet	T. C. Chawla
7	A Computational Technique to Assess Procedures for Failed-Fuel Identification	N. J. McCormick
16	Joint Probability Distribution of Neutron Counts in Reactor Noise Analysis	M. Marseguerra
27	Total Neutron Cross Section of Carbon from 1 keV to 15 MeV	H. T. Heaton, II, J. L. Menke, R. A. Schrack, R. B. Schwartz
37	Delayed-Neutron Data for Reactor Physics Analysis	R. J. Tuttle
72	A Theory of Resonance-Group Self-Shielding	M. Segev
	TECHNICAL NOTES	
83	Thermonuclear Microfission	F. Winterberg
84	Compact Tables of Functions for Use in Shielding Calculations	K. Shure, O. J. Wallace
94	A New Measurement of the ${}^{10}\mathrm{B}(n,\alpha)^7\mathrm{Li}$ Branching Ratio	G. P. Lamaze, A. D. Carlson, M. M. Meier
96	Calculated Nickel-58 Reaction Cross Sections Around 14-MeV Neutron Energy	B. S. Wadhwa, R. K. Mohindra
98	Measured Thermal-Neutron Cross Section for the $^{59}$ Ni $(n,\alpha)^{56}$ Fe Reaction	R. D. Werner, D. C. Santry
100	A Generalized Source-Multiplication Method for Determining Reactivity	Ehud Greenspan
103	A Source-Multiplication Reactivity	Ehud Greenspan
106	An Improved Series Representation of Doppler- Broadened Resonance Absorption	Arthur Ginsberg, Martin Becker
107	A Generalized Perturbation Theory and Variational Principle for Multiple Ratios of Linear and Bilinear Functionals	Ehud Greenspan

(Continued)

**VOLUME 56, NUMBER 1, JANUARY 1975** 

(Continued)

#### LETTER TO THE EDITOR

113 A Comment on Anisotropic Neutron Diffusion in Lattices P. Köhler of the Zero-Power Plutonium Reactor Experiments

#### **BOOK REVIEW**

114 Power Plants with Air-Cooled Condensing Systems, Paul Leung
E. S. Miliaras

Continued

# VOLUME 56, NUMBER 2, FEBRUARY 1975

117	Editorial: Metrication	
	TECHNICAL PAPERS	
119	Characteristics of Uncertainties in Sensitivity Studies of Fast-Reactor Parameters	R. N. Hwang
131	A Higher Order Relationship Between Static Power Tilts and Eigenvalue Separation in Nuclear Reactors	W. D. Beckner, R. A. Rydin
142	Application of Artificial Intelligence Techniques to Digital Computer Control of Nuclear Reactors	James L. Macdonald, Billy V. Koen
152	Computational Models for the Study of Azimuthally Dependent Disassembly of Liquid-Metal Fast Breeder Reactors	Paul B. Bleiweis, William E. Kastenberg, David Okrent
171	Tabulation and Empirical Representation of Infinite- Medium Gamma-Ray Buildup Factors for Monoenergetic, Point Isotropic Sources in Water, Aluminum, and Concrete	E. E. Morris, A. B. Chilton, A. F. Vetter
179	Experimental Determination of Photofission Neutron Multiplicities for Eight Isotopes in the Mass Range $232 \le A \le 239$	J. T. Caldwell, E. J. Dowdy
188	A Thermal Analysis of Hot Spots on Fast-Reactor Fuel Cladding Due to Deposition of Low-Conductivity Materials	M. Ishii, T. C. Chawla
196	Atmospheric Stability Inside Containments with a Heated Layer of Liquid on the Floor	Joh. F. van de Vate, A. Plomp
	TECHNICAL NOTES	
201	Partial Wave Expansion of the Induced Collision Kernel	B. R. Wienke
202	Practical Preprocessed Nuclear Data Files for Fast Reactor Calculations	Y. Gur, S. Yiftah
211	Subcritical Reactivity as Determined from Reactor Noise	Hsiao-Kang Wang, Lawrence Ruby
213	Reactivity from Power Spectral Density Measurements with Californium-252	V. K. Paré, J. T. Mihalczo
218	Direct Sampling from the Klein-Nishina Distribution for Photon Energies Above 1.4 MeV	László Koblinger
219	Additional Few-Group and Multigroup Calculations of	K. Shure

## (Continued)

Continued

**VOLUME 56, NUMBER 2, FEBRUARY 1975** 

(Continued)

#### LETTERS TO THE EDITOR

225	Comments on	"Finite-Element	Methods for	Reactor	Analysis"	J. P. Hennart	
-----	-------------	-----------------	-------------	---------	-----------	---------------	--

226 Response to "Comments on 'Finite-Element Methods for C. M. Kang, K. F. Hansen Reactor Analysis"

Continued

**VOLUME 56, NUMBER 3, MARCH 1975** 

### **TECHNICAL PAPERS**

Thomas W. Kerlin

229	An In-Pile Study of Thermal Interactions Between High- Energy Molten UO <sub>2</sub> Fuel and Liquid Sodium	S. M. Zivi, M. Epstein, R. W. Wright, J. J. Barghusen,
		D. H. Cho, F. J. Testa, G. T. Goldfuss, R. W. Mouring
241	Measured and Calculated Rates of Decay Heat in Irradiated 235U, 239Pu, and 232Th	S. B. Gunst, D. E. Conway, J. C. Connor
263	Point Isotropic Gamma-Ray Buildup Factors in Concrete	C. M. Eisenhauer, G. L. Simmons
271	Neutron Importance and Fission Density in Uranium-235- Enriched Uranium and Plutonium Metal Spheres	J. T. Mihalczo
291	Response Matrices in Space-Time Reactor Dynamics	J. M. Sicilian
	TECHNICAL NOTES	
301	Laser-Induced Thermonuclear Micro-Explosions Using Fissionable Triggers	W. Seifritz, J. Ligou
303	The EBR-I Incident: A Reexamination	Gerald S. Lellouche
307	An Assessment of ENDF/B-III Data for Uranium-238  Based on Integral Spectrum Measurements	Martin Becker, Narinder N. Kaushal
310	Directionally Discontinuous Harmonic Solutions of the Neutron Transport Equation in Spherical Geometry	A. A. Harms, E. A. Attia
317	A Numerical Method for Solving Integral Equations of Neutron Transport	S. K. Loyalka
	BOOK REVIEW	
320	Frequency Response Testing in Nuclear Reactors,	Robert W. Albrecht

Continued

**VOLUME 56, NUMBER 4, APRIL 1975** 

## CONTENTS

## TECHNICAL PAPERS

		A RESTAURANT OF THE PARTY OF TH
321	A Generalized Diffusion Theory for Calculating the Neutron Transport Scalar Flux	Raymond E. Alcouffe
340	Variational Functionals Which Admit Discontinuous Trial Functions	Paul Nelson, Jr.
354	Nonlinear Oscillations in a Reactor with Two Tempera-	James P. Keener,
	ture Coefficients	Donald S. Cohen
360	Calculational Methods for Nuclear Heating—Part I:	M. A. Abdou,
	Theoretical and Computational Algorithms	C. W. Maynard
381	Calculational Methods for Nuclear Heating—Part II:	M.A. Abdou,
	Applications to Fusion-Reactor Blankets and Shields	C. W. Maynard
399	Removal of lodide from LiF-BeF <sub>2</sub> Melts by HF-H <sub>2</sub>	C. F. Baes, Jr.,
	Sparging—An Application to Iodine Removal from	R. P. Wichner,
	Molten Salt Breeder Reactor Fuel	C. E. Bamberger,
		B. F. Freasier
	TECHNICAL NOTES	
	TESTITIONE ITS TES	
411	Transmission Probability Method of Integral Neutron	Hans Häggblom,
	Transport Calculation for Two-Dimensional Rectangular	Åke Ahlin,
	Cells	Takashi Nakamura
422	Zero-Power Noise Analysis in a Reactor with Two Weakly Coupled Asymmetrical Fission Zones	Eckart Viehl
427	A Benchmark Experiment of Neutron Propagation in	M. Martini,
	Iron Used to Test ENDF/B Cross-Section Data	G. Palmiotti,
		M. Salvatores
431	Power Reactor Calculations with the Finite Element	F. A. R. Schmidt,
	Program FEM 2D	H. P. Franke
	LETTERS TO THE EDITOR	
434	Comments on "Measurement of Anisotropic Neutron Diffusion Coefficients in Square Lattices of Aluminum in Light Water by the Pulsed Neutron Method"	M. M. R. Williams
434	Comments on "On the Randomness of a Neutron's Kinetic Energy as It Slows Down by Elastic Collisions in an Infinite Medium"	S. L. Paveri-Fontana

(Continued)

Continued

**VOLUME 56, NUMBER 4, APRIL 1975** 

## CONTENTS

(Continued)

436 Response to "Comments on 'On the Randomness of a C. S. Barnett Neutron's Kinetic Energy as It Slows Down by Elastic Collisions in an Infinite Medium"

#### **BOOK REVIEW**

438 Annual Review of Nuclear Science, Emilio Segrè, Ed. Eugene Guth

440 VOLUME 56 AUTHOR AND SUBJECT INDEXES



